Exploring Climate Change as an Opportunity for the reintegration of Environmental Health and Environmental Protection as a Field of Practice

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ABSTRACT

This paper explores climate change as an opportunity for the field of environmental health & protection (EHP) to address the divide it has suffered since the early 1970's, when diversification of EHP functions at the federal, state, and local levels led to the organizational and functional separation of environmental protection functions from environmental public health. Although this resulted in the creation of the Environmental Protection Agency and a broadening of the EHP system, it has also created fragmentation and gaps that negatively impact the ability of the system to effectively identify, respond to, and address emerging and increasingly complex issues.

Climate change is emerging as perhaps the most important public health issue of the 21st century. By many accounts, the US is already experiencing the impacts in the forms of extreme weather events and precipitation variances. Projected impacts will likely threaten the fundamental systems that support life and health; water, air food, ecosystems, affecting human health both directly and indirectly. Recognizing the need to address fragmentation and current silo-approaches to EHP issues, academia, public health leaders, practitioners, and professional organizations have worked to identify and implement strategies to strengthen the capacity of the EHP system. Climate change creates considerable greater urgency for systems change to ensure the capacity of the EHP system to adequate plan for and respond to such global EHP threats.

Understanding, planning for, and taking action towards climate change mitigation and adaptation will require a comprehensive and integrated environmental health and protection approach. Along with the challenges and barriers that exist, climate change also provides opportunities to redefine the EHP field, to affect organizational and workforce changes, and to bridge the separation between environmental public health and protection to more effectively

meet this and future environmental health challenges. The purpose of this paper is to review literature about and to recommend action for the reintegration of environmental health and environmental protection as a field of practice to prepare for and address climate change.

INTRODUCTION

Note that within this paper, environmental health and protection (EHP) will be used to refer to the environmental protection and environmental public health components of the environmental health field as a system.

Environmental health services and sanitation have been the backbone of public health in the United States since 1798 (CDC, 2003). The 20th century saw incredible gains in disease control and reduction in the areas of environmental health and protection (EHP), resulting in substantial quality of life improvements (CDC, 2003). However, by the middle of the 20th century, perceptions about man's relationship to the environment were changing. The 1960s and 70s was a time of growing national public awareness and focus on environmental protection; a shift from the traditional perspective of controlling the environment for the protection and use of man to protecting the environment from man (McNeill, 2001; Gordon, 1998a). This was in recognition of the negative impact human activities could have on the environment and of the complexity of many EHP issues (McNeill, 2001; Gordon, 1998a).

Until that time, at a national level, environmental health and protection activities were largely carried out by the US Public Health Service. With the transition of many of those programs to the EPA, states and counties soon followed suite (Johns Hopkins, 2008). This resulted in organizational and functional divides between environmental protection and environmental public health programs. Environmental protection programs have tended to enjoy greater public and political support, and therefore, more funding at a time when EH programs

located at the state and local level have experienced steady resource declines. At the same time, the EHP field was experiencing a break in the link to public health, with more and more practitioners coming from technical backgrounds that lacked a public health focus. What resulted has been described as an EHP system at a crossroads and severely challenged to meet today and tomorrows EHP challenges (Gordon, 2008; CDC, 2001).

Climate change has emerged as possibly the most important public health issue of the 21st century and certainly one with global health implications. Academia, EH professional organizations, and EH leaders have focused much attention of the past several decades to identifying the needs of the profession, and to developing and implementing strategies to meet them. Much of this work has focused on identifying core competencies, improving academic curricula, targeting capacity building at individuals and state and local agencies, and on influencing policy related to EHP. Significant voids in leadership, organizational divides, and the need for a systems approach have also been widely recommended to strengthen the system to ensure it is capable of meeting EHP challenges of today and the future (Gordon, 1998 & 2008; Orians et al., 2009)

Climate change, despite the challenges it poses, also provides an opportunity for the reintegration of environmental health and protection. Climate change is a complex, multifaceted issue. Expertise and strategies for reducing the factors that contribute to climate change, as well as promoting strategies that help populations plan for and adapt to climate change, will necessitate a comprehensive, multidisciplinary and interdisciplinary approach. To provide a comprehensive approach would require components of the EHP to functionally operate more closely, in a more integrated way to address ecological and human health protection issues associated with climate change. With efforts underway at the national and state level to develop

and implement climate change policy, EHP participation to ensure that such policies consider climate change impacts from an EHP approach is critical. Otherwise, EHP functions continue to be carried out in a fragmented approach, rather than comprehensively. A comprehensive approach would link the health of the environment to human health and help to implement strategies that are framed by a broad, public health perspective. Climate change mitigation and adaptation strategies offer opportunities in other areas of EHP. For example, efforts to mitigate the impacts of climate change through reducing greenhouse gas emissions can result in reducing overall volumes of traffic. Such initiatives may result in improved biking and walking paths, which increase physical activity, promote safer communities, and reduce motor vehicle related injuries.

LITERATURE REVIEW

20th Century EH Successes

Data published by the CDC in the MMRW (1999) identifies the increase in life expectancy in the US to have been 30 years since 1900, with 25 of those years of life gained due to improvements in public health. Many of those tremendous public health successes that resulted in increased life expectancy and increased the standard of living for millions were in the field of environmental health and protection through the reduction and control of disease and injury (McNeill, 2001; Orians, Rose, Hubbard, Sarisky, Reason, Bernichon, Liebow, Skarpness, & Buchanan, 2009). Improved sanitation, food safety, vector control, and water quality, traditional environmental public health focus areas had significant impacts on public health and disease prevention (McNeill, 2001; Orians et al., 2009).

The Organizational Divide of EHP

Despite these successes, by the late 20th century the, public health system in the U.S. was described as fragmented, neglected, and a system of siloes, with no one entity in charge and programs organizationally divided (Shalauta, Burke, Gordon, Stern, & Tran, 1999; Resnick, Zablotsky & Burke, 2009). This echoes the conclusion of the 1988 Institute of Medicine report in describing the complexity and fragmentation of the nation's public health system. At a national level, through the first half of the 20th century, the US Public Health Service (PHS) was responsible for a broad range of public health related issues and served as the primary federal agency for environmental health and protection (Parascandola, n.d.). The success of the PHS's Malaria Control Program in the control and prevention of malaria, dengue, and typhoid fever resulted in its conversion of the program into the Centers for Disease Control (CDC) in 1946.

Parascandola's history of the PHS (n.d.) details the transition of programs such as air and water pollution and solid waste from the PHS to other departments and agencies. Many programs were ultimately assigned to the Environmental Protection Agency (EPA) when it was established in 1970. In describing the organizational makeup of environmental health in the US, Gordon (1998) describes this period of transition of environmental health and protection responsibilities from the PHS to the EPA and a host of other departments and agencies (radiological health, occupational safety, housing, and pesticides) as a response to growing skepticism by both Congress and public health leaders that the PHS had the commitment to both adequately prioritize environmental health and to deal with the growing public and political demand for action on emerging environmental health issues (Gordon, 1998 & 2008; Berg, 2005). Similar organizational shifts followed at the state and local levels (Gordon, 2008). Historically, the responsibilities for activities in the field of environmental health and protection had been

within public health, over several decades these responsibilities have been divided and assigned across many agencies and levels of government (Johns Hopkins, 2008; Gordon, 2008). A 2008 report by the Johns Hopkins School of Public Health identified only 5 states that operate combined environmental protection and environmental health programs. In all others, environmental protection is organizationally and functionally divided from public health (Johns Hopkins, 2008).

The Fragmentation of EHP

This division of environmental health functions to a host of various agencies and entities at local, state, county, federal, and tribal levels has resulted in a complex environmental health network and the lack of a clear organizational structure with no one entity in charge (Johns Hopkins, 2008). Responsibilities are divided among federal, state and local agencies, all with significant variances in resources, authority, capacity (Johns Hopkins, 2008). The Pew Environmental Health Commission (2000) identified these gaps in the system of EHP and the lack of organizational structure as negatively influencing efforts to reduce and prevent acute and chronic diseases, including those linked to environmental conditions such as asthma, lung cancer, and birth defects.

Gordon (1998) identifies the failure of leaders in public health to recognize that environmental health is not just the activities practiced by health departments, but is a profession practiced by many in the field of environmental health and protection. Environmental health professionals includes those educated and trained in the field and practice of environmental health and are the minority by far, working primarily in health departments at the state or local level (Gordon, 1998). The majority of those working in the field of environmental health are professionals in environmental health such as scientists, engineers, and hydrologists, rather than

environmental health professionals. Thus, most professionals working in EHP have backgrounds other than in public health, including those working in local and state health departments. This has served to further the perception within and outside the EH profession that environmental public health is separate from environmental protection, when in fact, they are parts of the same whole (Gordon, 1998, 2006, 2008).

Practitioners recognized that fragmentation has resulted in a lack of operational collaboration and standardization between components of the EHP system. They further recognize that this vertical, or silo approach. "…makes it hard to communicate a coherent vision of environmental health" (Berg, 2005, pg. 11). EHP becomes defined by the organizational setting in which it is performed and the specific defined or adopted functions (inspections, permitting) carried out, rather than by a comprehensive definition of EHP. Gordon and Stern (1998) argue that the term environmental health & protection is a multidisciplinary field of practice, rather than a profession, and thus should be called environmental health and protection EHP) spell it out here to convey this and to eliminate the perception of separation between the environment and human health that the separate terms or organizational structure promotes. This term also better communicates environmental health and protection as a component of public health, regardless of where the responsibilities for activities and functions lie (Gordon and Stern, 1998). They define the goal of EHP as …" to ensure an environment that will provide optimal health and safety, ecological well-being, and quality of life for this and future generations" (Gordon & Stern, 1998, pg. 3).

Gordon (2008) discusses the failure of the US EHP system to overcome the fragmentation that resulted from diversification of EHP functions to modernize to a more comprehensive, interdisciplinary approach. He discusses this in relation to global warming, which he describes

as having the potential to devastate ecosystems and create serious EH problems. He asserts the importance of local EH agencies in responding, with an emphasis on the importance of acting as leaders or being left behind. Gordon specifically urges public health and EH leaders to:

- promote major improvements in environmental health and protection through leadership and the communication of a comprehensive vision for EHP;
- embrace the comprehensive field of EHP practice and build two-way bridges across organizational divides to improve practice;
- understand and embrace program marketing;
- engage in lobbying and public policy advocacy efforts as a role of leadership;
- education and workforce development for EH practitioners, regardless of organizational identify that trains ands and prepares individuals for the scope and breadth of EHP.
- develop a global warming prevention guide; and
- leading efforts to restructure health focused programs to be more organizationally aligned and administered to improve effectiveness and reduce redundancy.

Berg (2005) goes further in characterizing the fragmentation of the EHP system as not just organizational, but philosophical and territorial. This article refers to environmental public health and environmental protection as not just different components of the continuum that is the field of EHP, as others have described (Gordon, 2008), but as two separate fields. Tensions resulted from the need to compete for resources, support, and recognition (Berg, 2005).

The Philosophical Divide

Participants in Berg's article characterize an outcome of the diversification of the various EHP programs, for example water and air quality, as a series of siloes, much as the organizations themselves became, protective of what was viewed as their purview and often philosophically at odds. These motivations drove the environmental movement and the creation of the EPA. They also created philosophical divides. Berg (2005) describes the origins of the environmental

movement as spiritual, focused on protecting nature for its own sake. The environmental movement increasingly viewed EHP as part of the establishment and in business with industry, and thus, part of the problem. Berg describes a key disconnect between EP and EH as a "better safe than sorry" approach (environmental movement) versus a "show me the science" (traditional public health approach). This philosophical divide is further described by Berg (2005) as the environmental movement operating from a belief that science may not be advanced enough to capture or identify risk to the environment or human health in time to prevent significant harm or exposure. On the other hand, traditional public health is grounded in science as a basis for decision making and action.

Interviews with local and state EH practitioners indicated that environmental protection priorities can seem to place more importance on "…the health of the environment that the health of humans" (Berg, 2005, pg. 2) and that the lack of value placed on science creates mistrust. Conversely, the environmental protection participants indicated frustration with the reliance on science to link cause and effect, rather than a precautionary principle approach, when science can often lag far behind technology and chemical production (Berg, 2005). The article discusses the divide between the "show me the science" and the precautionary principle approach (Berg, 2005). The precautionary principle supports putting the burden of proof on scientific evidence that the activity or product is not harmful, rather than the current approach, which requires a burden of scientific evidence to prove harm before an activity or product will be regulated (Raffensperger, Schettler, & Myers, 2000).

According to Raffensperger, Schettler, & Myers, (2000), the precautionary principle offers an alternative approach to our current regulatory approach, which is failing to prevent eco-environmental damage including species collapse, climate change, and environmentally related

human health problems. The authors argue that the precautionary principle not only offers a different approach to regulation, but a framework for changing how we make decisions about activities that pose the risk of serious threat to human or environmental health. Smith (2000) agrees, arguing further that a precautionary approach must be integrated into decisions on environmental health policy. Berg (2005) concludes that the precautionary principle approach is prevention focused the same as the public health practitioners' approach, just viewed from a different lens. If seen in this light, the goal is the same and provides an EHP leadership opportunity to work together for that common goal (Berg, 2005).

In the past several decades, disease outbreaks, disaster response, climate change, and terrorism are examples of new and complex public health issues that have challenged the system and highlighted gaps in workforce competencies, infrastructure, organizational structure and leadership that limit the ability of EH to adequately address these emerging issues (Orians, et al., 2009; APHA 2011). Through surveys of EH practitioners to evaluate the effectiveness of community-based EH initiatives, Orians et al. (2009) found that many perceived local health agencies to be reactionary, operating in silos, working in disconnect from the community, and importantly, lacking "…effective linkages among environmental health, environmental protection, and public health" (pg. 876).

Systems Thinking

Efforts within public health over the past century have included better understanding relationships between risks factors and disease, and identifying better processes for protecting the public's health, based on those relationships and interconnectedness (Leischow & Milstein, 2006). Seeing the interconnectedness, the relationships between the parts is to see something as a system (Leischow, Best, Trochim, Clark, Gallagher, Marcus & Mathews, 2008).

Systems thinking is an approach to public health problems that has been applied more widely in industry and the social sciences until recently. It involves looking at the interconnections and system as a whole and recognizes the necessity of a multidisciplinary approach to understand causes and solutions. "**"**Simply put, a system is an organized collection of parts (or subsystems) that are highly integrated to accomplish an overall goal. The system has various inputs, which go through certain processes to produce certain outputs, which together, accomplish the overall desired goal for the system" ("Systems thinking", (n.d.). Arndt (2011), described challenges to improving environmental health practice within the Indian Health Service's (IHS), Division of Environmental Health Services (DEHS) which provides services to federally recognized American Indian/Alaska Natives in the US and includes a focus on providing traditional sanitation practices instead of a broader, more comprehensive and systems' thinking approach.

In recent years, the interconnectedness of issues and the necessity to compromise to balance environmental quality and human health interests has been recognized (APHA, 2011; Gordon, 2008; Orians et al., 2009). The public health approach is a framework for the systematic approach to identifying public health issues, their risk and protective factors, and evidence-based strategies for prevention. There are inherent benefits to a functionally connected and integrated working partnership of EP and EH which include linking the protection of the environment to human health and using a public health approach to address EHP issues. The reemergence of community health focused programs such as CDC's Protocol for Assessing Community Excellence in Environmental Health (PACE EH) and the involvement of community and grassroots organizations partnering with EHP programs are hallmarks of this paradigm shift within the field (Berg, 2005). Orians et al. (2009) describes the positive outcomes of PACE EH

projects detailed by EHP practitioners as including a reconnection with environmental protection programs to create stronger networks for EHP planning. The prevention approach of environmental health was described as a first cousin of the precautionary approach of environmental protection; closely aligned in purpose (prevention) and a basis for rebuilding bridges to create a more effective and broad based EHP system (Berg, 2005).

Education, Training, and Competencies for the EHP Workforce

Shalauta, Burke, Gordon, Stern, & Tran (1999) attribute the crossroads of the practice of EHP, in part, to the lack of adequate training for professionals in EHP. They detail the findings and recommendations of the Crossroads Colloquium, a forum of EHP leaders who came together in an effort to identify training needs and strategies for the profession. Today's EHP workforce is comprised of professionals and technicians from a wide variety of educational, professional, and work backgrounds due to the multidisciplinary nature of the field itself. As suggested by others writing on the topic, the lack of adequate technical and non-technical training, as well as the absence of public health training and backgrounds in much of the workforce, has contributed to individuals and systems that fail to approach EHP from the public health perspective and as a continuum across environmental public health and environmental protection. They fail to implement an integrated and comprehensive approach to the complex emerging and future EHP problems

Shaluta et al. (1999) argue that schools of public health have not met the training needs of EHP practitioners. At a time when we are facing emerging and increasingly complex EHP issues, budget cuts have further reduced the training available to assure professionals working in the field of EHP are adequately trained. According to research by Resnick, Zablotsky, & Burke (2009), only 30 accredited environmental health undergraduate or graduate programs are

available in the US. Regulatory mandates specific to the organizational setting in which EHP functions are carried out have defined the field, rather than the issues defining the work.

As advocated by Gordon, who participated in the forum, the Colloquium agreed that redefining EHP was necessary, as was a definition that reflected the expanded scope of the field of practice (Shaluta et al., 1999). The participants agreed upon the following definition, which reflects EHP responsibilities and functions that cut across organizational lines:

> ***Protection against environmental factors that may adversely impact human health or the ecological balances to long term human health and environmental quality, whether in the natural or human-made environment. These factors include, but are not limited to air, food and water contaminants; radiation, toxic chemicals, wastes, disease vectors, safety hazards, and habitat alterations (p 4).***

The colloquium participants focused on developing recommendations for broad based core competencies to include the non-technical skills necessary for the EHP workforce and strategies for improving the EH education system (Shaluta, et al, 1999). Non-technical competencies, which are also often referred to as professional skills, have been defined as:

> "a cluster of related knowledge, skills, and attitudes that affects a major part of one's job (a role or responsibility), that correlates with performance on the job, that can be measured against well-accepted standards, and that can be improved via training and development" (APHA,2001, pg 14).

In 2000, the American Public Health Association (APHA) brought together EH experts from across the country to further define core competencies for EH, focusing primarily on local level EH practitioners. The Environmental Health Competency Project was the result, identifying 14 core competencies necessary for EH effectiveness. This was an effort to identify key skills and gaps with the aim of translating competencies into improved training and ultimately, infrastructure and capacity, within local EH programs to meet emerging and future EH issues (APHA, 2001).

A. ASSESSMENT

- **Information Gathering:** The capacity to identify sources and compile relevant and appropriate information when needed, and the knowledge of where to go to obtain the information.
- **Data Analysis and Interpretation:** The capacity to analyze data, recognize meaningful test results, interpret results, and present the results in an appropriate way to different types of audiences.
- **Evaluation:** The capacity to evaluate the effectiveness or performance of procedures, interventions, and programs.

B. MANAGEMENT

- **Problem Solving:** The capacity to develop insight into and appropriate solutions to environmental health problems.
- **Economic and Political Issues:** The capacity to understand and appropriately utilize information concerning the economic and political implications of decisions**.**
- **Organizational Knowledge and Behavior:** The capacity to function effectively within the culture of the organization and to be an effective team player.
- **Project Management:** The capacity to plan, implement, and maintain fiscally responsible programs/projects using appropriate skills, and prioritize projects across the employee's entire workload.
- **Computer & Information Technology:** The capacity to utilize information technology as needed to produce work products.
- **Reporting, Documentation, and Record-Keeping:** The capacity to produce reports to document actions, keep records, and inform appropriate parties**.**
- **Collaboration:** The capacity to form partnerships and alliances with other individuals and organizations in order to enhance performance on the job.

C. COMMUNICATION

- **Educate:** The capacity to use the environmental health practitioner's front-line role to effectively educate the public on environmental health issues and the public health rationale for recommendations.
- **Communicate:** The capacity to effectively communicate risk and exchange information with colleagues, other practitioners, clients, policy-makers, interest groups, media, and the public through routine activities, public speaking, print and electronic media, and interpersonal relations.
- **Conflict Resolution:** The capacity to facilitate the resolution of conflicts within the agency, in the community, and with regulated parties**.**
- **Marketing:** The capacity to articulate basic concepts of environmental health and public health and convey an understanding of their value and importance to clients and the public.

(APHA, 2001).

Technical Competencies Covered in NEHA's Registered Environmental Health Specialist/Registered Sanitarian Exam

- Basic Environmental Health and Protection
- Basic Science
    - Toxicology
    - Physics
    - Chemistry
    - Geology
    - Biology
- Epidemiology
    - Environmental
    - Occupational
- Communicable Chronic Disease
- Environmental Law
- Risk Management

(APHA, 2001, pg 34).

As advocated by Gordon and Stern (1998), Shaluta et al. (1999), promote viewing EHP as a field of practice, rather than a specific profession, as an essential paradigm shift. This includes within academia. Shaluta et al. (1999) conclude that EH education should be redefined to reflect the multidisciplinary nature of the field to ensure that professionals in EH have the skills and knowledge required to apply a comprehensive, and ultimately, public health approach to EHP issues. This multidisciplinary picture includes nurses, engineers, epidemiologists, biologists, biostatisticians, ecologists to name a few (Gordon, 1998 & 2008). This change would be a shift from recent and current curricula which includes a focus on health care policy, but minimal emphasis on the core disciplines of public health such as epidemiology, and environmental health. Such a transformation of the education system will require collaboration between agencies, professional organizations, EH leaders, and academia to assure success (Shaluata, et al., 1999).

The Orians et al. (2009) research was focused on evaluating the effectiveness of the PACE EH framework for local environmental health programs to use in partnering with

communities to identify and address environmental health issues together, emphasizing community engagement and empowerment (CDC PACE EH, n.d.). Survey participant (EH practitioners) responses highlighted the impacts that engagement with the community and partners on EH issues had on broadening their perspective on what falls within the field of EH. For example, participants recognized how interconnected transportation, the built environment, and zoning/development are to environmental health and protection. Other outcomes relayed by participants included rebuilding relationships with environmental protection partners for a collaborative focus on EH issues, as well as stronger partnerships with other entities and jurisdictions for a more synergistic approach and perspective, rather than what has been the view of EH internally as primarily having a regulatory function (Orians et al., 2009). Leadership, a gap identified in the EH and PH workforce development in public health agencies, is a key focus of the PACE EH method. It also provides a means for implementing the 10 Essential Environmental Health Services (CDC PACE EH, 2001).

The 10 Essential EH Services

The 10 Essential Environmental Health Services is a framework that has been developed for identifying and implementing comprehensive, community-based EH services effectively and has been widely adopted by EHP programs nationally, including the Indian Health Service (DHHS) (IHS 10 Essential Services, n.d.). The essential services are identified as falling into 3 key categories: assessment, policy development, and assurance. These core functions are further expanded into ten essential services in Table 1.

Table 1: 10 Essential Environmental Public Health Services

(CDC 10 Essential EH Services, n.d.)

Assessment

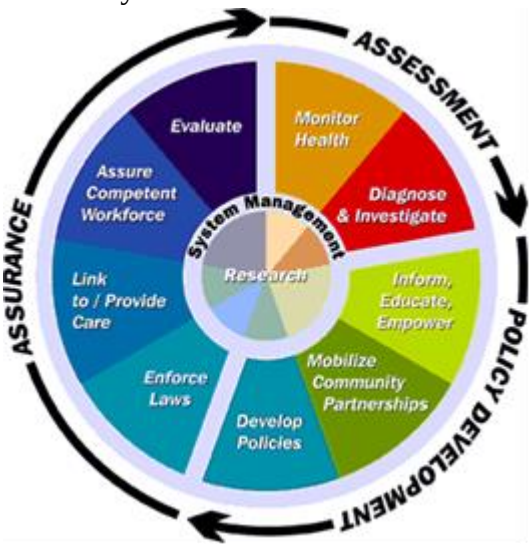
1. **Monitor** environmental and health status to identify and solve community environmental public health problems
2. **Diagnose and investigate** environmental public health problems and health hazards in the community

Policy Development

3. **Inform, educate, and empower** people about environmental public health issues
4. **Mobilize** community partnerships and actions to identify and solve environmental health problems
5. **Develop policies and plans** that support individual and community environmental public health efforts

Assurance

6. **Enforce** laws and regulations that protect environmental public health and ensure safety
7. **Link** people to needed environmental public health services and assure the provision of environmental public health services when otherwise unavailable
8. **Assure** a competent environmental public health workforce
9. **Evaluate** effectiveness, accessibility, and quality of personal and population-based environmental public health services
10. **Research** for new insights and innovative solutions to environmental public health problems



(CDC 10 Essential EH Services, n.d.; IHS 10 Essential Services, n.d.).

The 2002 UK Health Development Agency's report on the role of EH as a key partner in meeting future public health goals echoes several of these key points regarding the shrinking scope of EH practice, concern about the fragmentation of the EHP field, and the negative impact the focus on prescribed and regulatory enforcement responsibilities have had on effective practice. Unintended negative consequences of the diversification of the EHP system included the practice of EH becoming organizational and function specific, with EHP commonly defined by the functions being carried out (inspections and permitting, for example). Within public

health, there has been a growing shift towards health care and treatment, and away from the traditional population and community health. Over decades, the relationship and collaboration between environmental protection and environmental public health programs continued to erode, with public health more and more removed from ecological health issues and operating from a regulatory approach, rather than more holistically and with the issues driving the work.

The Health Development Agency report (2002) outlines the essential components of a strategic EH vision to reinvigorate the profession and reintegrate a focus on assessing and addressing broad determinants of health. The connection that EH practitioners have to the local community, the holistic view of how various factors impact human health, and the direct influence the functions of EH have on both human health and maintaining healthful environments illustrate the importance of EH in both EH practice and leadership roles. Surveys of EH practitioners conducted as part of the research for this report indicated a desire to implement a more holistic approach to EH practice, but organizational structure and prescriptive practice duties have created significant barriers to such changes in approach that are necessary for effective EHP. Also significant was the impact of EH and organizational leaders without public health backgrounds on the direction and strategic vision of EH programs. As described in this report, this shift contributed to EHP being reduced to its regulatory functions and a move away from a comprehensive public health approach that focused on broader determinants of population health (Health Development Agency, 2002, pg 5).

The authors stress that the resulting lack of skill development and dissatisfaction in the existing EH workforce, as well as the limited scope of environmental health practice, is contributing to the decreasing number of individuals entering EH training and education programs (Health Development Agency, 2002). The report outlines key roles for EH

practitioners in meeting the nation's public health goals based on a strategic vision that embraces a broader scope of practice and a more holistic, integrated approach. Training, organizational restructuring, benchmarks, and skill testing are emphasized in their vision document, as is dedicated lines of funding and resources to achieve these objectives. The report emphasized public health leadership and strategic planning as essential to success in creating and maintaining an effective EHP system (Health Development Agency, 2002).

From at the Mercy of Nature to Molding Nature to the Needs of Man

J. R. McNeill (2001) writes about the environmental impacts that have occurred in the 20th century. He suggests that fundamental changes in how we live occurred in the last hundred years. These changes include the ability of human activity to impact the planet for the first time. He describes the successes in quality of life and the human condition as directly linked to the availability of cheap oil. Cheap and plentiful oil fueled the industrial revolution and led to tremendous population growth and movement. These changes allowed man to realize improvements in the quality of life for millions. However, these same advancements have shaped many of the environmental challenges we face today and will face tomorrow (McNeill, 2001). Ecosystem destruction, the migration of toxic chemicals throughout ecosystems on a global scale, and climate disruption from greenhouse gasses are examples of global impacts that are directly linked to human activity. However, according to the author, a perception gap remains between man's historical view of man's relationship to nature and the realities of the modern age of global environmental impact. This historical view of being at the mercy of nature and man lacking the ability to have any lasting negative impact on the earth is not in line with modern realities that industrialization, the population explosion, and technological advances have given us the ability to mold the environment to our needs.

A challenge we face in addressing growing environmental threats to human health is the view held by many from the past century that our impact is small and insignificant. Further, the ability of man to manage and manipulate the environment – to change the flow of rivers and create agricultural valleys in deserts - has lent itself to the view that no matter what happens, we can use technology and science to fix it (McNeill, 2001).

Climate Change and EHP

Luber and Hess (2007) characterize climate change as a "novel public health problem with unprecedented scope, timeline, and complexity" (Luber and Hess, 2007, pg. 44). The interdependence of the natural environment and human health is termed eco-environmental health by Strand, Tong, Aird, & McRae (2010). Much work over the past several decades to revitalize the EHP system has been in anticipation of such a far-reaching, complex public health issue. The recognition of climate change as an emerging and now significant EHP problem has served to not only highlight challenges, but also the opportunities for public health to regain a leadership role in environmental issues. Climate change is ultimately a public health issue (Gordon, 1998). The health of the environment and public health are intrinsically linked and will require an integrated environmental protection and public health approach to understand and address them. This is an opportunity to create the systems change that has been advocated over the past several decades, to include realigning EHP programs organizationally and functionally to create a more integrated system. This crisis also provides opportunities to capitalize on public and political support for climate planning and action to create fundamental changes with EHP practice, to include adoption of appointment and performance standards, changes in funding for EH programs to move away from prescriptive and mandated service approaches, and to affect paradigm shifts within and without the field on the role and scope of EHP.

Three broad categories of health impacts are associated with climatic conditions: impacts that are directly related to weather and climate; impacts that result from environmental changes that occur in response to climatic change; and impacts resulting from consequences of climate-induced economic dislocation, environmental decline, and conflict (McMichael, & Martens, 2002). Despite the growing awareness of climate change as a potentially serious global threat, a perception gap exists between that awareness and connecting awareness to human health threats and actions to avert such threats (Portier, Tart, Carter, Dilworth, Grambsch, Gohlke, Hess, Howard, Luber, Lutz, Maslak, Prudent, Radtke, Rosenthal, Rowles, Sandifer, Scheraga, Schramm, Strickman, Trtanj, Whung, 2010). The authors (Portier et al., 2010) suggest this is because climate change continues to be portrayed by the media as primarily an ecological threat. Coverage is most often related to disappearing ice caps and associated species challenges. Such presentations make the issues seem abstract and hard to connect to human activity, both in the sense of contributing human activity and strategies to reduce or prevent climate change effects. Climate research has also focused primarily on environmental impacts, so there is a dearth of information on human health effects. According to Portier, et al. (2010), it is clear that climate change endangers human health, but there is need to improve the science and knowledge base on how it occurs in order to anticipate and respond effectively, and equally importantly, guide the public and policymakers on these issues.

This was affirmed in the summary reports on climate change and health by the Chartered Institute of Environmental Health (Stanwell-Smith, 2008), which identified key public health impacts of climate change to be in the areas of heat and weather extremes; injuries and infections related to storms and weather variants; respiratory health issues from degraded air quality; food production and quality issues; water quality and availability challenges; and increased

vectorborne and zoonotic diseases. Climate change has the potential to undo many of the public health and quality of life advances that EHP was instrumental in achieving in the 20th century (Stanwell-Smith, 2008). The report suggested that the perception of health risk would significantly influence the individuals willingness to take environmental action, and that this disconnect has already delayed development of policy towards climate change mitigation and adaptation within the public health system (Stanwell-Smith, 2008).

EHP has a key role to play in adaptation and mitigation planning and action, as well as in efforts to build community resilience to climate change. Mitigation is aimed at reducing the sources and emissions of greenhouse gases. Adaptation is defined by the Intergovernmental Panel on Climate Change (IPCC) as the natural or human systems adjusting to the actual or expected effects of climate change. Resilience, although a term often used interchangeably with adaptation, might be more correctly understood as the capacity to effectively respond to the effects of climate change and even recover from or thrive (Stanwell-Smith, 2008).

While mitigation strategies were proposed for reducing greenhouse gas emissions, the CIEH report argues that EHP should be more focused on adaptation strategies to increase community resilience to climate change because mitigation alone will not be effective and will take years to have a measurable impact (Stanwell-Smith, 2008; Environmental Defense Fund, 2008; Ebi, Kovats, and Menne, 2005). Adaptation includes the strategies, policies, and measures taken to reduce the eco-environmental health impact of climate change. Key considerations in adaption planning are strategies to strengthen the adaptive capacity of communities and populations; that is, their capacity to cope with the effects of climate change (Ebi, Kovats, and Menne, 2005).

Surveillance and climate models are in the early stages of development and use in trying to understand and predict climate impacts. Only recently have climate model developers recognized the need to downscale global models to local and regional levels. Localizing climate threats is now viewed as inherently important in motivating local and regional action and policy. Downscaling helps answer the "so what does this mean to me?" questions (Cooney, 2012). As policy makers begin recognizing the need for and moving forward with climate policy work, the presence and role of EHP is important in framing climate change as a public health issue and communicating that despite the uncertainty and gaps in scientific knowledge about the issue. , Strategies to assess vulnerability and implement adaptation measures should begin (Stanwell-Smith, 2008; Auld, Hatcher, 2010). EH promotion is defined as "any planned process employing comprehensive health promotion approaches to assess, correct, control, and prevent those factors in the environment that can potentially harm the health and quality of life of present and future generations" (Howze, Baldwin, and Kegler, 2004, pg 1). Health promotion concepts have not been widely implemented within the EH field in the past, which Auld et al. suggest may have been causative in the lack of healt protectionmhas resulted in the lack of proficient environmental health promotion specialists as well as a lack of robust environmental health education interventions directed to both the general population and those communities specifically coping with environmental contamination (Auld, Hatcher, 2010). Adaptation planning and preparation should also include considerations of unintended negative consequences and competing interests. The authors use grey water reuse and potential infection and pollution risks associated with this practice as an example (Stanwell-Smith, 2008).

The Environmental Defense Fund conducted a survey of public health representatives in 2008 to determine how they perceived climate change health risks and the level of preparedness

and capacity within their organizations. More than 70% responded positively that climate impacts were already being experienced within their jurisdictions and will be experienced in the next 20 years (Environmental Defense Fund, 2008). Interestingly, although more than half of program directors felt that climate change preparation was an important priority; very few identified it as an actual program priority in their organization (Environmental Defense Fund, 2008). However, the survey also revealed a lack of perceived expertise to prepare for public health problems that arise from climate change. Seventy-seven percent of local health directors felt they lacked the expertise to assess local health impacts of climate change in their region, and 83% felt they lacked the expertise to craft adaptation plans. Local health directors did not perceive that much help is currently available from their state or federal public health agencies (Environmental Defense Fund, 2008).

In the 2009 article on strengthening the EH workforce, Resnick, Zablotsky, & Burke emphasize systems, competencies, relationships, and resources as critical for meeting the mission of public health. The changing scope of environmental health to include global challenges, such as climate change and water shortages, requires an interdisciplinary, comprehensive approach. Such issues and failures of the public health system to adequately respond and protection the public health during disasters such as Hurricane Katrina, have shone a spotlight on the critical importance of effective public health and infrastructure gaps. Decades of declining funding has had direct and indirect negative impacts on that workforce: morale, training, understaffing, loss of program components and narrowed scope, recruitment and retention issues, and weakened core programs. On the issue of climate change, although many of the impacts are within the purview of local and state EH programs, such as food, water, and air quality, it is unclear to what extent public health professionals are associating the

impacts been seen with climate change and responding accordingly (Environmental Defense Fund, 2008).

Despite these significant and pervasive EHP workforce issues, Resnick et al. (2009) identify opportunities for strengthening the EHP workforce. Technological and scientific advancements provide great potential for improving public health capacities. Other significant opportunities include the greater awareness of environmental health issues and ecological perspectives that can influence interest in pursuing careers in EHP, as well as the attention and support the Obama Administration has shown in regards to public health prevention and climate change issues (Resnick et al.2009; Gordon, 2008). EHP leadership development and action is vital for translating these opportunities into a strengthened, restructured, and coordinated EPH system (Resnick et al, 2009).

According to Gerding and Price (2012), opportunities for and examples of improvements in EHP systems to improve efficiency and effectiveness include funding and the adoption of performance standards. This article discusses the funding for public health prevention through the Affordable Care Act of 2010. Grants were provided to 76 health departments across levels of government in the US to implement capacity building and performance management strategies. Implementation of Environmental Public Health Performance Standards provides a mechanism for integrating the 10 Essential Environmental Health Services into the performance framework. This allows for a systems-level assessment of performance and the identification of key areas for improvement. Examples of outcomes and impacts in health departments that had implemented the performance standards to improve performance management included uniting EH programs with partners and stakeholders; of improved data sharing across organizational boundaries; and greater understandings of roles and responsibilities amongst partners (Gerding and Price, 2012).

In 2003, CDC issued the National Strategy to Revitalize EH in response to growing recognition that EH programs and the EHP system was not adequately prepared and structured to address the growing complexity of EHP issues and emerging threats such as climate change, reemerging vectorborne diseases, and terrorism (CDC, 2003). CDC identified the leadership role the agency should play in efforts to build capacity at local, state, tribal and regional levels to improve infrastructure and EHP response. The report also strongly emphasized a focus on building practitioner-level leadership and system capacity. The strategy for revitalization included the following goals and objectives:

- Build capacity to include improving access to technology and other tools;
- Support research to better define effective approaches to emerging EH issues;
- Foster leadership to enhance partnerships and leadership within EH;
- Communicate and marketing to enhance the understanding of EH; and
- Develop the workforce to include defining scope of work and competencies needs to meet emerging EH needs.
- Create Strategic Partnerships to advance goals and initiatives and improve communication ad interaction among stakeholders. (CDC, 2003).

The CDC, the National Association of City and County Health Officials (NACCHO), the National Environmental Health Association (NEHA), and the American Public Health Association (APHA) have all undertaken initiatives aimed at the revitalization goals identified in the CDC's 2003 plan. Examples include Mobilizing for Action through Planning and Partnerships (MAPP). MAPP is a framework for community health improvement through strategic planning that involves focuses on community empowerment and leadership. In partnership with public health, the community identifies and prioritizes public health issues and

the resources available or needed to address them. Both the process of strategic planning and prioritizing, and the partnership with the community are aimed at ultimately improving community health and public health performance (NACCHO MAPP, n.d.).

The promulgation and adoption of National Public Health Performance Standards (NEnvPHPS) and the integration of the 10 Essential Services of Environmental Public Health have also focused on building capacity through workforce development and program performance. The CDC has used funding as a mechanism to strengthen environmental health capacity, providing cooperative agreement grants that address improving EH service delivery, EH capacity to respond to emerging and future threats, and improving the science base in EH to directly improve EH practice (CDC Capacity Building, n.d.).

The NEnvPHPS provide a mechanism for measuring performance based on impact. This is significant shift from the way program effectiveness has been widely measured within EHP programs in the past; numbers of functions performed (inspections for example) or similar counts of something done. Moving to impact measures will also require a focus on improving the infrastructure. This will be a shift in focus from measuring functions to identifying and implementing ways to measure impact on protecting and improving health (Buchanan, 2007).

Leadership development, recognized widely as a gap in EHP, has been a focus across EHP professional organizations, to include the CDC through its Environmental Public Health Leadership Institute (EPHLI). The EPHLI is a yearlong leadership development fellowship that targets leadership development among the participants, who largely come from local and state EH programs. Participants complete a public health leadership project, generally aimed at strengthening and/or capacity building within their respective organizations. The process encourages the development and exercise of systems thinking, team building, visioning, and

critical thinking to enhance EH outcomes and service capacity. In other words, systems level changes versus process and functional changes alone to achiever broader, systems level impacts and outcomes (CDC EPHLI, n.d.; Leischow et al., 2008).

Brooks, Adger, & Kelly (2005) conclude that national-level climate change indicators are needed as part of a methodology for assessing vulnerability to climate change impact. These indicators would serve as a basis for mitigation and adaptation strategies, to include capacity promoting effort (mitigation) to address identified vulnerabilities. Mitigation and adaptation efforts, although unlikely to eliminate vulnerabilities, could serve to build adaptive capacity and thereby reduce the significance of the impact. Using a systems approach to build adaptation capacity at a community level was identified as a strategy to have a broader impact beyond a specific issue (climate change) to promoting overall environmental quality and sustainability and suggested as more impactful in building community resilience to hazards such as climate change than disaster response or post event response (IPCC, 2007).

Despite the seriousness of environmental health issues facing our world, Hecht, Fiksel, Fulton, Yosie, Hawkings, Leuenberger, Golden & Lovejoy (2012), identify the growing science and technology in the field of sustainable development as showing promise for promoting health and economic interests. For this article, sustainability was defined as meeting society's needs without undermining environmental quality to meet future needs (pg. 63). The authors describe the corporate trend globally to adopt sustainability plans, which incorporate three pillars: social well-being, economic prosperity, and environmental protection. A corporate focus on sustainability can be a driver on innovation while maximizing the efficient use of resources to minimize environmental impact. Moving from traditional relationships between government and business to a more collaborative approach on environmental issues is critical to move

sustainability from awareness and practice into policy and law. The authors detail the opportunity to create shared value across lines of government, industry, and society globally. Rising energy costs, resources challenges, economic stresses and public awareness are all factors currently driving sustainable development actions in industry (Hecht, et al., 2012).

RESEARCH METHODS

This study of climate change as an opportunity for the reintegration of EHP as a field of practice was done through a literature review. Sources included professional and trade journals, books, conference presentations and educational materials, as well as agency and organization websites and published materials. In order to identify relevant articles and other sources, I used search terms related to environmental health and climate change, public health impacts of climate change, the state of the environmental health professions, competencies and education for environmental health professionals, leadership, systems thinking and public health. The reference lists for papers and articles selected for review were also used to identify additional sources.

The following databases were searched in conducting this review:

Pubmed and Medline, which index over 3,600 international medical and health care journals (1949 to present);

Academic Search Premier, which indexes abstracts for over 8,500 journals, and full articles for more than 4,600 of them (1975 to present);

GreenFILE, an ecological database through which one can access scholarly and general interest titles, as well as government documents and reports;

Google Scholar, which is Google search engine that indexes scholarly literature on topics to include, but not limited to, science and technology;

Academic OneFile, which indexes more than 50 million articles from journals covering the physical sciences, technology, medicine, social sciences (from 1980 to the present).

Academic Search Complete, which indexes articles for more than 4,000 popular and scholarly journals and abstracts for over 8,200 journals (1975 to present); and

UNC University Libraries, which was a primary source for this literature review.

In total, 62 articles, publications, and sources (web based information) were identified for inclusion in this paper. Twelve examined infrastructure and needs related to environmental health competencies, education and training. Fifteen sources primarily examined climate change, sustainability, and the role of public health. Fourteen of the 62 sources reviewed for this paper examined policy, leadership, and systems approaches, directly or indirectly related to environmental health or climate change. Fourteen of the sources examined the field of environmental health practice, included the divide between the environmental movement, environmental health, and environmental protection. Finally, seven sources focused on approaches to community based practice and strategies for localizing efforts and adaptation planning.

FINDINGS

The literature points to the diversification of environmental health and protection functions across agencies and levels of government as resulting in part from a growing concern about the complexity of EHP issues and a cultural shift to valuing the importance of protecting the environment from human degradation (Berg, 2005; Gordon, 2008; Johns Hopkins, 2008). However, most sources agree that despite the historic successes of EHP in protecting health and improving the quality of life for millions of individuals, the organizational divisions have resulted in a fragmented, complex, and functionally divided EHP system (Gordon, 1998; Orians et al., 2009).

Despite the IOM (2008) report describing the public health system as disjointed in both

service and policy-making, Gordon (1998 and 2008) proposes that the diversification of EH from public health agencies might have been desirable as a mechanism to dissociate EH from health care and the growing move of public health programs to align themselves with healthcare. Gordon further suggests this diversification was necessary to create a system diversified enough to meet the complexity of EHP challenges.

Many of the successes of the 20th century that made the tremendous public health advances possible may be contributing to the looming public health threat that is climate change (McNeil, 2001). Cheap oil is part of every story of technological advance, globalized economies, development, and even public health and health care advances (McNeil, 2001). The impacts of climate change may threaten the most basic necessities of health: water quality and supplies, food production and safety, air quality, and vectorborne and zoonotic disease distributions (Stanwell-Smith, 2008).

Several sources describe environmental health and protection activities as carried out by agencies other than health departments and departments of health. Responsibilities for programs such as air, noise, and water pollution control; industrial discharges and accidental spills; brownfields clean-up and redevelopment; hazardous materials control; and managing hazardous waste sites are spread across many agencies, organizations, and levels of government. This is described as a complex system with no one entity ultimately in charge of EHP (Johns Hopkins, 2008, Gordon, 1998; Berg, 2005).

The literature describes these organizational separations as have resulting in functional and operational separations as well (Resnick, Zablotsky, Burke, 2009). Several sources described the lack of interconnectedness between program and the silo approach to programs and issues. Although the health of the environment both directly and indirectly affects human health,

environmental protection programs have been organizationally split from environmental public health programs in all but 5 states in the US (Berg, 2005; Johns Hopkins, 2008; Gordon, 1998 & 2008).

Several articles indicated that a key challenge for EHP lies in defining itself, its scope of work, and the role of EHP in climate change response. There is disagreement and confusion about these issues, even within the field (Berg, 2005; Gordon, 2008). Even when identifying the fragmentation between local/state EH programs and other agencies and organizations responsible for EHP functions, the authors lack a unified definition of the field and the scope (Gordon and Stern, 2008; Shaluata et al; 1999; Berg, 2005). The need for redefining EHP in terms of the field of EHP, rather than defining it in terms of where the organizational responsibilities for EH activities were highlighted by several articles. The argument was that narrowly defining of EH by function and organizational divide creates gaps in the practice and the capacity of the EHP system to function effectively – as a system that is ultimately focused on public health (Gordon, 1998; Shaluata et al., 1999; Gordon and Stern, 2008). Several articles further described the need for EHP programs to be organizationally aligned to promote functional and operational alignment, arguing that the terms environmental health and environmental protection are the same except for the organizational settings in which the functions and activities are carried out (Gordon, 1998; Shaluata et al., 1999).

A significant focus in the literature was on the importance and lack of EHP leadership in creating organizational and policy change (Gordon, 1998; Resnick et al., 2009). Much of the effort in recent years to strengthen the environmental health infrastructure and build leadership has been predicated on the view that we have created an EHP system that may not be able to meet modern and future EH issues, especially as the world becomes more global. Climate

change was widely described as having the potential to be the most significant public health issue of this century (APHA, 2011; IPCC, 2007).Climate change is predicted to have local, regional, national, and global impacts and will require a linked public health system, to include a comprehensive EHP system, and approach (Luber & Hess, 2007; Gordon, 2008). Awareness of the connection between the environment and human health and the need a systems thinking approach was identified by several authors, to include the applications to climate change (Arndt, 2011; Berg, 2005; Orians et al., 2009).

The literature identified the lack of a PH and EHP presence at the table for climate change policy and action planning (IPCC, 2007). Climate change is still most widely seen as an environmental protection issue rather than a human health concern (APHA, 2011; Bedsworth, 2007). There was much agreement in literature that climate change is ultimately a public health issue and that EHP involvement and leadership is critical in understanding, planning for, and responding to it's impacts (Gordon, 2008; APHA 2001 & 2011). There was significant emphasis on a more integrated, systems-thinking model, such as the implementation of the PACE EH approach to community based EH initiatives (Orians et al., 2005; CDC EPHLI, n.d.). Literature on climate change suggested that a key challenge for individuals in affecting change is to address the disconnect between the concept of climate change and local impact; to make it relevant, understandable, and important to the individual and at a local level (IPCC, 2007; Luber and Hess, 2007; Bedsworth, 2009).

However, despite a significant amount of literature detailing the importance of public health involvement in climate change planning and action, there were not a lot of specifics about EHP in terms of roles, scope of practice, and the types of organizational change that were needed. Literature emphasized the importance of having public health representation and

leadership at the table in developing climate policy and strategies for mitigation and adaptation. However, EHP was not widely identified specifically.

Another gap in the literature was that despite broad agreement on redefining (broadening) the definition and scope of EHP and implementing a systems-thinking approach that focused on interconnectedness and a multidisciplinary approach, there were few specifics. Examples seemed limited to partnering on programs and initiatives, versus substantial organizational alignment of programs. No clear framework for example, was identified for an eco-environmental health approach within programs. What the literature review did not identify to any significant degree or in any significant detail was examples of integration of protection into traditional environmental health programs or success in moving back from environmental health programs focusing on prescriptive or mandated services to one that bases environmental health action on issues of greatest public health significance and community focused approaches that drive this.

Also, despite policy change and systems thinking approaches being emphasized in literature, specific examples of the role of EH and PH on climate focused more on educating individuals about behavioral change and policy change. There was minimal emphasis on changing relationship with government and business or focusing on organizational, community, and government level change (NEHA, 2010; APHA, 2011; Bedsworth, 2007).

Several articles explored the image traditional environmental health faces of being seen as part of the establishment, bureaucratic, focused on regulation and slow to act until science can link a cause and effect (a scientific standard is set). Environmental protection advocates argue that a precautionary approach that recognizes that the potential eco-environmental health outcomes may be serious enough in some instances to warrant a “better safe than sorry”

approach (Berg, 2005; Gordon, 1998) This can be a significant divide between these two groups and create mistrust, with traditional public health citing the lack of science (Berg 2005) to support links to health impact and environmentalists considering public health as favoring industry and not recognizing that science may not be advanced enough to make the connection until long after exposures, harm, or irreversible environmental degradation has occurred (Smith, 2000, Raffensperger 2000)

CONCLUSIONS AND RECOMMENDATIONS

The fragmentation of the EHP system has resulted in significant gaps in practice that have been highlighted by severe weather events, chronic chemical exposures, and novel disease and vector trends in recent years. Programs and EHP activities targeting air quality, water, food, vector control, emergency preparedness, sustainability, built environment, and healthy housing are operated by many agencies and organizations. Efforts often are not collaborative, so a silo approach exists which fails to have the comprehensive impacts that an integrated approach could.

Climate change is a complex, multifaceted issue that will require significant partnership, interconnectedness, and a multidisciplinary approach to understand and address the factors that influence it, and strategies to protect human health and the environment. These very challenges posed by climate change also provide opportunities to reintegrate EHP to address the operational and functional divides that are barriers to the comprehensive, interdisciplinary approach required for effective climate change mitigation and adaptation.

An example of integration might include efforts in the area water resources related to climate change. Projected sea level rise may threaten habitat, housing, wildlife and drinking water supplies. Drought will threaten both ground and surface water supplies used for drinking

water. Competing interests cannot be discounted either. Agriculture, industry, recreation, and consumers will be competing for potentially shrinking drinking water resources. Policies and programs that promote water conservation and resource protection must be collaborative with local policies and initiatives on gray water reuses, recharge and zero-scaping, for example, to create a unified vision of the problems and approaches to address them.

Climate change policy and planning is underway at state and federal levels. However, public health may not be the primary focus of mitigation and adaptation planning and action. Environmental impacts and outcomes are more closely linked to environmental protection than to public health in the minds of the public and policy makers. Public health has not shown effective leadership in persuading policy and decision makers that public health considerations warrant the same or greater consideration as the economic and environmental interests. EHP leadership will be critical in ensuring policy and action planning addresses the human health impacts of climate change. This will require leadership and action in reframing climate change as a public health issue. As advocated in several of the articles reviewed for this paper, academia, professional organizations, and EHP practitioners must take on the role of developing leaders and in stepping into leadership roles to effect change. EHP practitioners should play a central role in identifying and advocating for opportunities to build bridges between programs to operationally close gaps in the EHP system and strengthen overall capacity to address complex and emerging issues. An integrated EHP approach to this is important for reframing the issue to include redefining a healthy environment as essential to human health.

Climate change provides an opportunity to more fully integrate systems-thinking approaches and other frameworks (EH Performance Standards and 10 Essential Services of EH) into operational practice. Implementing systems-thinking would include considering new

partnerships and ways of doing business, such as working collaboratively with industry rather than primarily in a regulator capacity. Partnerships with industry as a key player in the health of a community are vital because industry will play a central role in climate change mitigation and adaptation. Industry is a major consumer of water and energy resources, a major producer of goods and services that affect and shape the lives of individuals, communities, and nations. Mitigation strategies have emissions reduction at their heart. Industry partners in shipping and transportation are essential for effective emissions reduction. Partnership with industry to identify adaptation strategies may also promote innovative versus regulatory approaches to meet this goal by through defining the desired outcome while allowing industry to design technologies and strategies for achieving those outcomes.

Many of these efforts will create a foundation for other successes as well. Co-benefits for EHP include examples such as partnerships with diabetes prevention programs, parks and recreation, and transportation to promote walking and biking thru the construction of biking paths to reduce greenhouse gas emissions related to motor vehicles. Co-benefits of less traffic and safer walking and biking routes include improved health, reduced motor vehicle crash injuries, and improved green spaces. Thus, by bringing more programs and partners together to identify broad strategies to address climate change, other desired health and environmental protection goals can be achieved that might not be possible through a more divided approach. While an individual agency might promote carpooling or increased physical activity, by partnering with zoning, transportation, health education, diabetes prevention, parks and recreation and similar programs, walking and biking routes might be constructed or improved, walk-to-school and walk-to-work program initiated, and incentive programs through employers offered to encourage and promote less driving and safer biking and walking. Such efforts may

also result in more green spaces and community parks, while also reducing motor vehicle traffic and motor vehicle injuries, and improving air quality. An initiative such as Safe Routes to School, which is a grant-based program aimed at increasing safe walking routes to schools, is an example of an opportunity for partnering with other entities and agencies to expand the impact and outcomes of the original idea. Rather than simply enhancing biking and walking routes within 2 miles of schools, broader partnerships might expand biking and walking paths much further through the community, offer opportunities to increase physical activity of the community population, rather than school children only, and reduced overall traffic and traffic related injuries.

EHP leadership must communicate a vision for an integrated system to build support for changes within and outside the field. This means being able to create and communicate a comprehensive vision for how operationally and functionally realigning EHP programs will address the fragmentation and gaps in practice to improve program and health outcomes, as well as to create greater capacity to plan for and address climate change. Using the 10 Essential Services of EH as a framework for climate change planning and action in an integrated, systematic approach is one potential strategy and starting point for EHP leaders.

By identifying the specific focus areas or activities associated with each of the essential services, key partners and gaps between programs can become apparent and help clarify where an integrated, collaborative effort amongst EHP programs and agencies is necessary or would significantly improve the outcomes. For example, the first of the 10 essential service is monitoring. As the literature emphasized, data to better predict, anticipate, and understand the direct and indirect influence of climate change on environmental and human health condition, as well as to inform mitigation and adaptation strategies is essential. Within EHP, only an

integrated effort to identify, collect, analyze, and apply the wide range of data needed to develope prevention and protection approaches will be effective or even feasible.

An example of a 10 Essential EHP services for climate change, highlighting activities and examples, is provided below.

Example: 10 Essential EH Services for Climate Change

1. **Monitor** environmental and health status to identify and solve community environmental public health problems.

    - Data from across the EHP system, with examples identified in bullets below, will be essential for effective climate change planning and response.
        - Vulnerable populations
        - Climate model projection data
        - Environmental risks and meteorological data
        - Ecological data
        - Disease surveillance information
        - Environmental exposure data
        - Community input and qualitative data
        - Identification of climate change indicators
        - Community resource capacity and needs assessments

2. **Diagnose and investigate** environmental public health problems and health hazards in the community.
    - Identify environmental and human health impacts or risk factors related to climate change
    - Develop systems and processes for collecting, analyzing, and acting on data and information
    - Protocols for investigating and determining negative outcomes associated with climate
    - Build overall lab system capacity to better understand the physical, chemical, and biological linkages to be able to attribute health outcomes to climate change impact

3. **Inform, educate, and empower** people about environmental public health issues

    - Reframe climate change as a public health issue to connect environmental impacts to health
    - Make the issue concrete and local, helping individuals understand the significance and anticipated impact.
    - Partner with individuals, community members, leaders, policy makers, industry and organizations on community based initiatives to build levels of support for policy and action. This would include

- An integrated approach Develop an approach that addresses all system components and partners to identify and implement mitigation and adaptation planning and policy.
- Disseminate climate change information to decision makers at all levels.
- Develop marketing, social media, and fact sheets to inform and empower the public and leaders about climate change
- Apply GIS and other technology to community monitoring data

4. **Mobilize** community partnerships and actions to identify and solve environmental health problems

    - Bring together a broad base of key partners (mayors and other elected officials, emergency response personnel, planners, zoning, transportation, health, policy, media, and social organizations)
    - Unify efforts and initiatives where possible to avoid redundancy, and to implement a systems approach to maximize the impacts.
        - EPA's Environmental leadership programs
        - Green building and other sustainability initiatives
        - Voluntary leadership and compliance programs
    - PACE EH and other such community based, grassroots focused initiatives aimed at building community level involvement and grassroots action.
    - Seek input and involvement from a broad group of individuals and programs, such as transportation, planning, city and county leadership, parks and recreation

5. **Develop policies and plans** that support individual and community environmental public health efforts

    - At all levels (local, community, state, regional), identify policies and planning to reduce and address climate change impacts. Integrate policy and planning goals and implementation for broader and more comprehensive approach and impact.
    - climate change action planning and implementation
    - organizational and programmatic policy changes
        - Redefining scope of practice, responsibilities, outcome measures
        - Redefining organizational structure and alignment of EHP programs
    - Develop policies and policy statements that support climate change mitigation and adaptation
    - Integrate monitoring data into policy and plans

6. **Enforce** laws and regulations that protect environmental public health and ensure safety

    - Transportation, water and energy conservation, waste stream reduction and hazardous waste management are examples.
    - Identify opportunities for incentive programs in addition to punitive enforcement approaches to create partnerships with industry

- Transition to a performance based regulatory/enforcement approach where possible to maintain the focus on the outcome and intent of the standard, while providing incentives and flexibility to the public and industry in achieving those outcomes.

7. **Link** people to needed environmental public health services and assure the provision of environmental public health services when otherwise unavailable

    - Maintain and communicate resources available across the EHP system related to climate change
    - Maintain communication and relationships with non-traditional partners to better serve the public and link them to resources
    - Identify resource gaps and needs

8. **Assure** a competent environmental public health workforce

    - Provide training in technical and non-technical topics (leadership, public speaking, policy, public health) across the EHP system
    - Challenge schools of public health to move back to public health focused curricula that adequately emphasizes the fundamental program areas of PH
    - Develop plans for competency models, standardization and adopting performance standards.
    - Identify strategies for outcome evaluation
    - Utilize PACE EH and other approaches that build cross-cutting competencies
    - Develop opportunities for cross training within the EHP field
    - Identify training and competencies related to climate change and sustainability

9. **Evaluate** effectiveness, accessibility, and quality of personal and population-based environmental public health services

    - Evaluate the development and implementation of climate change plans
    - Evaluate the effectiveness of incentive programs
    - Evaluate workforce development measures
    - Provide performance measures reports up, down, and out to partners
    - Evaluate public perceptions, awareness, and preparedness.

10. **Research** for new insights and innovative solutions to environmental public health problems

    - Climate models for public health planning, especially local and regional modeling capabilities
    - Methods for linking human health to environmental impact
    - Effectiveness of sustainability, mitigation, and adaptation strategies

Effective EHP climate change response will require a systems-thinking approach across the field of practice, as well as leadership for policy and organizational change. This not only poses significant challenges, but also an opportunity for EHP leaders to affect organizational alignment within the EHP system to reduce the fragmentation and gaps that have been widely identified over the past several decades. Successful reintegration of environmental protection and environmental public health programs will not only result in greater capacity for effective climate change response, but improvements in effectiveness of core program outcomes that have been identified as negatively affected by organizational and program divides. EHP leadership from within the practice, trade and professional organizations, and within academia will be required to create a vision for such changes, as well as to effectively champion for and affect the changes through public policy and organizational change.

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